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AN ECONOMIC FEASIBILITY STUDY OF FAYETTEVILLE, NORTH CAROLINA, TREATING FORT BRAGG'S WASTEWATER

D. Nelson, et al

Army Construction Engineering Research Laboratory
Champaign, Illinois

March 1973

TECHNICAL REPORT E-9
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by
D. Nelson
J.E. Matherly

CONSTRUCTION ENGINEERING RESEARCH LABORATORY
Champaign, Illinois

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Construction Engineering Research Laboratory
P.O. Box 4005
Champaign, Illinois 61820

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
AN ECONOMIC FEASIBILITY STUDY OF FAYETTEVILLE, NORTH CAROLINA, TREATING FORT BRAGG'S WASTEWATER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Technical Report

5. AUTHOR(S) *(First name, middle initial, last name)*
D. Nelson
J. E. Matherly

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 1973	28	7

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	E-9
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	AD# obtainable from address block 1.

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Copies of this report are obtainable from National Technical Information Service, Springfield, VA 22151	Department of the Army

13. ABSTRACT

This study was conducted to evaluate the economic feasibility of Ft. Bragg's entering into a cooperative wastewater treatment system with the Public Works Commission of the City of Fayetteville, North Carolina. Present and anticipated standards of treatment applicable to Ft. Bragg were defined, and the condition and efficiency of both the present wastewater treatment plant and the collection system were assessed. Based on these findings, the following alternatives were defined:

1. Ft. Bragg treating its own wastewater
2. Fayetteville treating all of Ft. Bragg's wastewater
3. Fayetteville treating the portion of Ft. Bragg's wastewater which flows toward Fayetteville by gravity

Ft. Bragg treating its own wastewater was found to be most economical. Recommendations were made to modernize or replace the present wastewater treatment plant and to upgrade the collection system.

14. KEY WORDS
advanced wastewater treatment
regional wastewater treatment
wastewater treatment costs

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED
Security Classification

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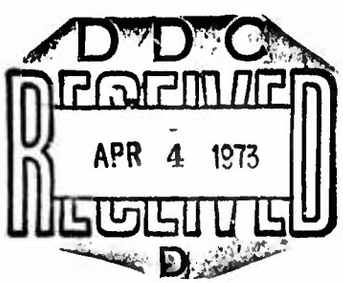

Department of the Army
CONSTRUCTION ENGINEERING RESEARCH LABORATORY
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FOREWORD

This report was conducted in response to Intra-Army Order 33-72, from Ft. Bragg to the Construction Engineering Research Laboratory. This is the final report detailing methods and results of a preliminary study of the economic feasibility of Ft. Bragg contracting or otherwise joining with Fayetteville, NC, for a treatment of their combined wastewater in a municipal facility.

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AN ECONOMIC FEASIBILITY STUDY OF FAYETTEVILLE, NORTH CAROLINA, TREATING FORT BRAGG'S WASTEWATER

1 INTRODUCTION

Objective. The objective of this study was to evaluate the economic feasibility of Ft. Bragg, NC, entering into a cooperative wastewater treatment system with the Public Works Commission of the City of Fayetteville, NC.

Scope. For purposes of identification and definition of the wastewater treatment alternatives available to Ft. Bragg, present and anticipated standards applicable to Ft. Bragg wastewater treatment plant effluent were defined. The condition and efficiency of both the plant and the collection system were assessed from existing information. Proposed schemes of Ft. Bragg's joining with Fayetteville for purposes of wastewater treatment were identified and defined. Cost estimates for the feasible alternatives were generated for comparison.

Background. The Fayetteville Public Works Commission contacted Ft. Bragg to discuss the possibility and feasibility of treating all or part of Ft. Bragg's wastewater with a municipal wastewater treatment plant, currently being designed. The new wastewater treatment plant is to be located south of Fayetteville at the confluence of Rockfish Creek and the Cape Fear River. This Rockfish plant, as currently proposed, would be designed to treat a flow of about eight million gallons per day. The proposed scheme of treatment is primary treatment by sedimentation, the extended aeration version of the activated sludge process, and tertiary treatment by dual-media filtration and chlorination. The effluent is to be discharged into the Cape Fear River at the site of the plant.

Ft. Bragg is currently using trickling filters for secondary treatment of wastewaters. Removal efficiencies of 80–85% for both five-day biochemical oxygen demand (BOD_5), and suspended solids (SS) are indicated in Ft. Bragg wastewater treatment plant records. The Third Army Medical Laboratory Department of Environmental Health Engineering (DEHE) confirmed the general reliability of Ft. Bragg wastewater treatment plant operating data in a short study; conducted in May 1972. A formal report of DEHE results was not available at the time of completion of this study; however, preliminary data was obtained by telephone conversation with DEHE personnel.* From an Environmental Protection Agency (EPA) survey[1] and personal communication with Ft. Bragg personnel,** major problems were revealed at Ft. Bragg in terms of discharge of untreated wastewaters, sewer infiltration, and poor physical condition of wastewater collection and treatment facilities. Effluent from the Ft. Bragg wastewater treatment facility is discharged into the Little River, approximately 25 miles above its confluence with the Cape Fear River.

Fayetteville authorities have a completed study for a regional wastewater treatment master plan which could incorporate provision for treatment of Ft. Bragg's wastewater in the proposed Rockfish treatment plant.[2] Figure 1 indicates the relative locations of Ft. Bragg, Fayetteville, and the proposed treatment plant at the confluence of Rockfish Creek and the Cape Fear River.

Ft. Bragg requested this economic feasibility study of the alternatives available to them – namely, to join or otherwise contract with the Fayetteville Public Works Commission for treatment of Ft Bragg's wastewater, or to continue treating their own wastewater with existing or new facilities. New facilities including tertiary filtration were assumed throughout this study. This results in a "maximum cost" alternative for Ft. Bragg treating its own wastewater for comparison to cost figures generated from Fayetteville's proposals.

* Personal Communication, Lt. Richard Bell, Third Army Medical Laboratory Department of Environmental Health Engineering, Ft. McPherson, Georgia, 8 June 1972.

**Personal Communication, James Ake, Wastewater Treatment Plant operator, Ft. Bragg, NC, May 1972.

[1] *Report on Waste Disposal Practices at Ft. Bragg Army Reservation* (Environmental Protection Agency, Region IV, 1972).

[2] *Comprehensive Water and Sewer Plan, Cumberland County, North Carolina* (Wilbur Smith & Associates, 1971).

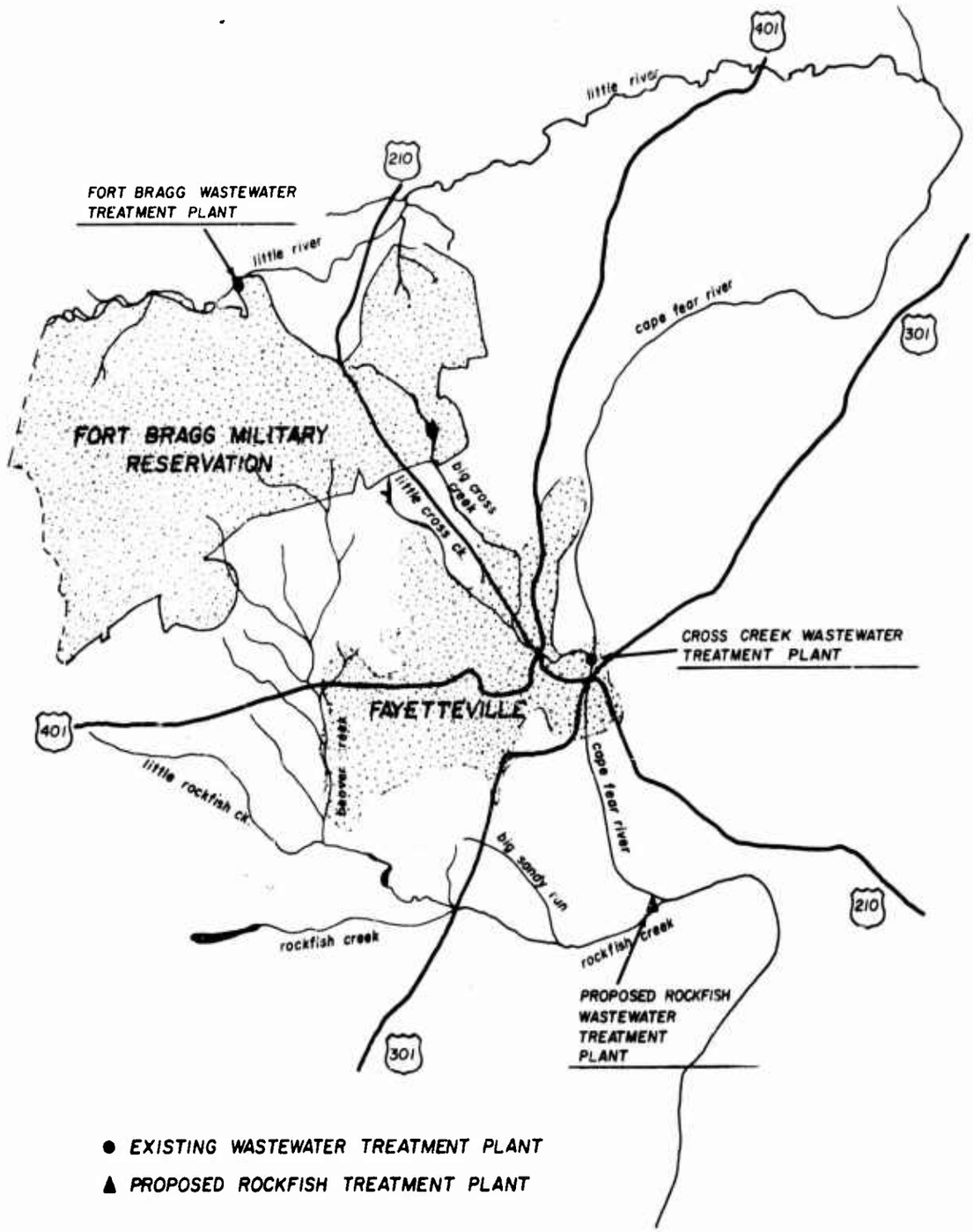

Figure 1. Fort Bragg-Fayetteville area.

2 EFFLUENT STANDARDS APPLICABLE TO FT. BRAGG

The State of North Carolina follows the usual practice of classifying surface waters according to their use. Public policy is to classify a surface water as high as practical, but the classification is based on the actual use of the water. Any discharge is regulated to maintain the standards of water quality applicable to the classification of the surface water into which the effluent is discharged.

Ft. Bragg takes its raw water from the Little River and discharges its treated wastewater about a mile downstream. The Little River is classified A-II from its source to the dam at the Ft. Bragg water intake. From this dam to its confluence with the Cape Fear River, it is classified D. The Cape Fear River is classified A-II at its confluence with the Little River, and it changes to class D at U.S. Highway 301, below Fayetteville's water intake. Therefore, the quality of Ft. Bragg's effluent must be good enough not only to maintain the Little River as class D, but also to protect the A-II classification of the Cape Fear River after the Little River joins it. The best usage, conditions related to best usage, and the applicable quality standards for class A-II and class D waters are listed in Appendix I.

At present, Ft. Bragg is under relatively lenient standards to provide secondary treatment and 85% removal of BOD_5 and SS. Since the allowable effluent quality is a function of the characteristics of the raw waste, this standard should be considered subject to revision. Many states have more stringent standards that define an absolute effluent quality. North Carolina can reasonably be expected to make its standards more stringent in the near future.

Although an exact prediction of future requirements is impossible, reasonable estimates can be made based on the standards of other states and on the designed effluent quality of proposed sewage treatment plants in North Carolina. Standards as low as 4 milligrams per liter (mg/l) BOD_5 and 5 mg/l SS have been applied in Illinois. The proposed Rockfish plant, at the confluence of Rockfish Creek and the Cape Fear River, is designed to produce an effluent containing 5 to 7 mg/l BOD_5 and 5 to 7 mg/l SS. Officials of the Federal Facilities Branch of the EPA in Atlanta, Georgia, indicated that they considered design for effluent BOD_5 and SS of less than 10 mg/l in a proposed plant acceptable.* An effluent standard on the order of 15 mg/l for BOD_5 and for SS would seem likely for existing plants in the near future. Approval of a new plant will probably require design for less than 10 mg/l for BOD_5 and for SS.

Furthermore, the North Carolina Office of Water and Air Resources (NCOWAR) is presently concerned with delayed dissolved oxygen depletion, the most likely cause of which is oxygen demand due to nitrification. The possibility of an ultimate BOD standard to control delayed dissolved oxygen depletion was under discussion at the North Carolina Office of Water and Air Resources during May 1972. An extended aeration activated sludge plant with a very low effluent BOD_5, such as the proposed Rockfish plant, would probably meet these standards. A trickling filter effluent cannot meet these standards without additional treatment.

The implication of such effluent standards for Ft. Bragg is severe in terms of existing facilities capabilities. The addition of dual- or multi-media filtration to the existing trickling filter plant would likely increase removal of BOD_5 and SS by 50% and 90% respectively. A 50% reduction in BOD_5 by filtration to meet an effluent standard of 10 mg/l BOD_5 limits the maximum filter influent BOD_5 to 20 mg/l. DEHE studies during May 1972** indicated effluent (potential influent to filtration) BOD_5 values of 18–49 mg/l. To meet 10 mg/l SS in filtration effluent implies no more than 100 mg/l SS in filter influent. Other considerations, such as length of filter run and backwash requirements, become more important in considering filtration of high levels of SS concentrations. The same DEHE study indicated a range of 22–31 mg/l SS, with an average of 28 mg/l SS in the final effluent of existing facilities. One may conclude that filtration of effluent might eliminate SS concentrations above 10 mg/l, but it probably would not reduce effluent BOD_5 to meet likely standards.

*Personal Communication, Mr. Dave Olsen, Federal Facilities Branch, Environmental Protection Agency, Atlanta, GA, 9 June 1972.

**Personal Communication, Lt. Richard Bell, Third Army Medical Laboratory, Department of Environmental Health Engineering, Ft. McPherson, GA, 8 June 1972.

3 EVALUATION OF WASTEWATER TREATMENT AT FT. BRAGG

The present wastewater treatment plant at Ft. Bragg was designed in 1937–38, built in 1939–41, and opened in 1941. It consists of a bar screen, comminutor, and a grit chamber with mechanical grit removal equipment preceding four primary settling tanks, two trickling filters, and four final clarifiers. Two anaerobic sludge digesters are used, followed by sludge drying beds. Recirculation is practiced, but the rate is not adjustable. Effluent chlorination is also practiced on a continuous basis.

The plant was designed for 85% removal of BOD_5 and SS, and this is presently the approximate operating efficiency. The sludge digesters are working well and the effluent causes very little oxygen depletion in the Little River. The plant is well-operated and maintained, operating with the efficiency expected of a trickling filter plant. The only major operational change recommended by the Environmental Protection Agency and the Third Army Department of Environmental Health Engineering studies is to make the recirculation rate adjustable. The EPA and DEHE studies are good sources for detailed information about present plant facilities and operation.

If the BOD_5 and SS removal efficiencies of the Ft. Bragg plant were always better than 85% on a monthly average, the effluent would be in compliance with state and federal standards. This is not always the case, however; the monthly averages have been below 80% at times. Considering the lack of any problems attributable to Ft. Bragg's effluent, these small deviations from the standard will probably not be of a controversial nature. The standards can only become more stringent, however, and soon Ft. Bragg may find it necessary and desirable to achieve an effluent having lower average SS and BOD_5 concentrations.

Both the physical wastewater treatment facility and its design are obsolete by today's standards. Waiting for a state or federal regulatory agency to require upgrading of treatment is not an acceptable alternative. Executive Orders 11507 and 11514 both require that the federal government provide leadership in protecting and enhancing the quality of the nation's environment. Therefore, it is more than appropriate that cooperative advanced waste treatment with Fayetteville be considered at this time. However, the alternative to this cooperative effort should not be the continuted operation of the present sewage treatment plant, but the design and construction of a new advanced waste treatment plant or extensive modernization of the present plant, including the construction of additional treatment facilities, such as filtration.

Several other facets of the present wastewater system also need upgrading. Three of the six pumping stations need extensive rebuilding or replacement. The Little River outfall has broken away and is eroding the bank. Sections of sewer mains reportedly have large infiltration problems.* Even more critical are the wastewater discharges which are not treated. The EPA *Report on Waste Disposal Practices at Ft. Bragg Army Reservation* recommends several reroutings of oily and washdown area wastes to the sanitary sewers. The Pope Air Force Base plane wash wastes are discharged directly to the Little River just below Ft. Bragg's water intake. Furthermore, both the sedimentation basin sludges and the filter backwash wastes from the water treatment plant are discharged directly back into the Little River.

All of these problems are much more urgent than improving the present degree of treatment, but the choice of cooperating with Fayetteville or updating treatment at Ft. Bragg has a direct effect on several of these problems. The infiltration problem and the untreated discharges must be corrected regardless of the choice of treatment alternatives.

4 ECONOMIC ANALYSIS

General. In this section, current Ft. Bragg costs are presented and estimates are calculated for Ft. Bragg's continuing to treat its own wastewater or contracting with the Fayetteville Public Works Commission for wastewater treatment. Present cost information was obtained chiefly from the wastewater plant operator. A complete new wastewater treatment plant including a tertiary filtration step is assumed for Ft. Bragg's continuing to treat its own wastewater, resulting in a maximum cost for this alternative. Four possible cooperative systems with Fayetteville are considered, and costs are estimated for each. The four

* Personal Communication, James Ake, Wastewater Treatment Plant operator, Ft. Bragg, NC, May 1972.

Table 1
Operating and Maintenance Costs for Sewage Treatment Plant

	FY 70	FY 71	FY 72
Materials (80% of annual)	$ 8,600	$ 8,900	$18,100
Labor (8/11 of annual)	53,700	66,200	73,800
Self-Service Store (50% of annual)	400	400	400
Work Orders	400	400	400
Electricity	3,600	3,600	3,600
Truck (80% of annual) ($2500 @ 4½% for 6 yrs).	400	400	400
Truck (80% of annual) ($.95/hr. @ 1560 hr/yr)	1,200	1,200	1,200
Truck (80% of annual) ($.60/hr. @ 1560 hr/yr)	700	700	700
Office, Lab and Ground Supplies	500	500	500
Half of chemist's salary	5,000	5,000	5,000
Water and Heat	500	500	500
Volar* Labor (8/11)	0	3,700	16,700
Total	$75,000	$91,500	$121,300

*Volunteer Army

possible cooperative systems result from Fayetteville's treating all or part of Ft. Bragg's wastewater under Fayetteville's stated terms or under the best terms Ft. Bragg could expect to negotiate. All cost estimates for the possible alternatives are adjusted to June 1972 figures by the *Engineering News-Record* Sewage Construction Cost Index.[3]

Present Costs for Ft. Bragg. Ft. Bragg reports its present cost for wastewater treatment as $.06 per 1000 gal. Compared to commonly stated costs for wastewater treatment, this cost is unreasonably low. The reasons are that operating and maintenance (O&M) costs have not been fully considered, and capital costs have been omitted from consideration. Table 1 has been developed from information obtained from the wastewater treatment plant operator.* FY 72 figures are estimates based on figures available for 10 months of FY 72.

The concept of an amortized capital cost for the present Ft. Bragg sewage treatment plant is not a reasonable approach. The plant is over 30 years old and has outlived its projected life. A more sensible approach is to look at other expenditures which have a long term value and which were not included as O & M costs in Table 1. Some of these costs are really for maintenance, while others may be identified as modernization costs.

In 1968–69, $547,000 was spent on the plant to eliminate the flocculator, to repair a rising and tilting clarifier, and to rebuild the digesters. Also, $2440 was spent for sand for the drying beds in FY 72, and a duplicate purchase will be made in FY 73. Other major expenditures are necessary. The outfall has broken away and is eroding the bank of the Little River. The plant recycle system needs to be made adjustable. Even the digesters and titled clarifier may require additional work in the near future.

Assuming that an additional $200,000 will have to be spent and that all these costs will be spread over a 10 year period, an average yearly cost for major maintenance and rehabilitation may be estimated as follows:

$547,000
2,440
2,440
200,000

$751,880 or $75,200 per year.

Table 2 is a summary of treatment costs for FY 70, FY 71, and FY 72.

[3] *Engineering News-Record*, 2nd Quarterly Cost Roundup, Vol 188, No. 25 (McGraw Hill, 1972) pp 65, 67.

*Personal Communication, James Ake, Wastewater Treatment Plant operator, Ft. Bragg, NC, May 1972.

Table 2
Treatment Costs Summary

	FY 70	FY 71	FY 72
Operating and Maintenance	$ 75,000	$ 91,500	$121,300
Major Maintenance or Modernization	75,200	75,200	75,200
Total Costs	$150,200	$166,700	$196,500
Gals Treated ($X10^9$)	1.80	1.75	1.70
Costs per 1000 gals	$ .083	$ .095	$ .115

Table 3
Pumping Station Use and Energy Requirements

Station	HP	% Time Running (8–12 a.m.)	Total Dynamic Head	Flow (10^3 gals. per day)	Ft-Lb per Day
1	100	44.6	135	700	787,279,500
2	50	6.6	140	90	104,970,600
3	50	17.5	135	250	281,171,250
4	7.5	25.0	60	75	37,489,500
5	10	53.7	60	150	74,979,000
6	5	8.7	85	13	9,205,605
				1,278	1,295,095,605

Pumping station use and energy requirements are tabulated in Table 3. This information was also obtained from wastewater treatment plant personnel.*

At 50% overall efficiency and $.0125 per kwhr, the cost per year for electricity is $4,455.

Table 4 shows the complete operating and maintenance costs for the pumping stations. The 20% – 80% split for materials, vehicles, etc., and the 3 – 8 split of the 11 men between the pumping stations and the treatment plant was suggested by plant personnel.*

Ft. Bragg's treatment costs are just about what one would expect for a trickling filter, although they are rapidly increasing. The pumping costs, however, are very high, due primarily to large labor costs. Plant personnel indicated that the equivalent of three men work on the pumping stations full time. This labor allocation appears excessive for operations that are self-running and could even be remotely monitored.

Anticipated Costs If Ft. Bragg Continues to Treat Its Own Wastewater. As previously discussed, Ft. Bragg will have to replace or extensively modernize its present plant within a decade because of age and more strict standards. A new wastewater treatment plant for Ft. Bragg, including a tertiary filtration step, will be assumed in this analysis. In order to compare this alternative with having Fayetteville treat all or part of Ft. Bragg's wastewater, a common cost base must be established. For this economic analysis, it will be assumed that the infiltration problems will be rectified regardless of which alternative is chosen. The costs to be compared are any plant, sewer, or pumping station costs, as well as anticipated Fayetteville charges and anticipated operating and maintenance costs, for all the systems considered. Both an operation and maintenance cost and a total cost to the government will be calculated on a yearly basis by assuming an amortization at 6% for 25 years for the government's capital expenditures.

The present Ft. Bragg wastewater flow is about 4.7 million gallons per day (mgd). No major population change is in the long range plan for Ft. Bragg, although

* Personal Communication, James Ake, Wastewater Treatment Plant operator, Ft. Bragg, NC, May 1972.

150 family housing units are planned and another 500 are being considered. Exact placement of these units has not yet been fixed, although the Little River side of the base area is being considered. With the addition of water treatment plant and wash rack wastewater flows, about 5 mgd may be expected.

One very important aspect of designing a new plant is the allowance for mobilization of Ft. Bragg, Ft. Lee, in its negotiations with Hopewell, Virginia, is reserving capacity for full mobilization. Such an approach has serious economic consequences. The probability of full mobilization and the relative amount and importance of environmental damage in this situation must be evaluated. Of major importance is the response of the treatment system to overloads and the ease with which the system may be expanded. Fortunately, Ft. Bragg does not have to evaluate these considerations immediately. For purposes of this study, a new treatment system will be sized for present and projected waste loads, without mobilization. The old plant might be kept in operating condition for emergency use until these mobilization considerations are resolved.

The present plant is designed for about 6.25 mgd. Flow rates as high as 12 mgd have been recorded under the most adverse conditions. During the three months with highest wastewater production, the average approaches 6 mgd and the daily high approaches 8 mgd. Therefore, an activated sludge plant designed for about 8 mgd would be adequate for present needs and considerable increases. Designing for more than 8 mgd would probably be unnecessary as there is an inherent flexibility in an activated sludge system.

Although a tertiary treatment step is not necessary to meet present standards, future standards may very well require this. The proposed Rockfish plant is designed with a tertiary filtration process, and a similar process has been included in a cost estimate to build a new plant for Ft. Bragg.

For Ft. Bragg to continue to treat its own wastewater, the following construction would be required:

1. An 8 mgd activated sludge plant with tertiary filtration and chlorination; facilities should be provided for chemical addition at the filters and space left for expansion and the addition of supplementary treatment steps.

2. Replacement of pumping stations #1, #2, and #3.

Table 5 lists the anticipated costs involved with this alternative.

It must be noted that the estimates of pumping station sizes and costs are based on very sparse information, which also has a great deal of data spread. A complete engineering survey must be made to accurately size these pumping stations. Any costs due to pumping stations #4, #5, and #6 are neglected because they are common to all the assumed alternative systems.

Anticipated Costs If Fayetteville Treats All of Ft. Bragg's Wastewater. If Fayetteville treats all of Ft. Bragg's wastes, the major construction necessary on Ft. Bragg would be one or several pumping stations on the Little River side of the base to pump the wastewater to the Beaver Creek and Rockfish Creek watershed. An interceptor network would have to be developed to

Table 4
Operating and Maintenance Costs for Pumping Stations

	FY 70	FY 71	FY 72
Materials (20%)	$ 2,100	$ 2,200	$ 4,500
Labor (3/11)	20,000	24,800	27,700
Volar Labor (3/11)	0	1,400	6,200
Self-Service Store (20%)	100	100	100
Work Orders (20%)	100	100	100
Truck (20%)	100	100	100
Truck (20%)	300	300	300
Truck (20%)	200	200	200
Electricity	4,500	4,500	4,500
Total	$27,500	$33,700	$43,700
Gallons pumped (10^3)	466,500	466,500	466,500
Cost per 1000 gals pumped	$.059	$.072	$.092

Table 5
Costs for Ft. Bragg to Continue to Treat Its Own Wastewater
(in thousands of dollars)

Item	Capital Cost	Amortized Capital Cost	O&M	Yearly Cost to Gov't
8 mgd A.S. Plant with Tertiary Filtration	$4,050	$317	$309	$626
Pumping Station #1	50	4	6	11
Pumping Station #2	35	3	5	7
Pumping Station #3	30	2	4	6
TOTAL	$4,165	$326	$324	$650

join the Fayetteville Public Works Commission's interceptor near Beaver Creek. It might be possible, however, to do away with all or most of the present pumping stations except #6. Fayetteville would have to build a larger initial plant as well as a larger interceptor along Rockfish Creek and Beaver Creek.

One factor which was considered was the reduction in flow of the Little River if the effluent was not returned. The Little River flow, as measured approximately 2 miles below the Ft. Bragg water treatment plant, is 256 mgd on the average. The seven-day, ten-year low is about 28.5 mgd. Furthermore, the North Carolina Office of Water and Air Resources has no record of any downstream users, so that Ft. Bragg would not be likely to violate riparian rights even if it took out and did not return up to 12 mgd, but discharged it into another watershed (Beaver Creek).

Several gross assumptions must be made to estimate Fayetteville's charge to Ft. Bragg. The most critical of these is Ft. Bragg's portion of the wastewater treated. This would start out very high and gradually decrease as more and more of the serviced area is connected. Furthermore, the serviced area load and the Rockfish plant will both be expanded. The only reasonable approach is to estimate Ft. Bragg's share of the initial plant by comparing the size of the plant to be built with and without Ft. Bragg's participation. This should be fairly accurate as an average cost to Ft. Bragg over the first 5–10 years of operation. Ft. Bragg's cost under this system should be very high at first and gradually decrease as plant and sewer capacity are more fully utilized. Economics of scale will enhance this effect as the Rockfish plant is expanded. As indicated in Appendix II, the charge to Ft. Bragg would be calculated as follows:

1. 4% depreciation on Rockfish plant and interceptor sewers per year.

The Rockfish plant sized at 16 mgd would cost about $6,810,000. The sewers along Rockfish and Beaver Creeks would cost about $1,290,000 more with Ft. Bragg in the system than without them (Appendix III). If Fayetteville's estimate of the total cost for the Rockfish system without Ft. Bragg is $9,000,000 (Appendix IV) and $3,500,000 is allocated for the plant, $5,500,000 is required for the interceptors. Then the total costs to be depreciated are:

$ 6,810,000
1,290,000
5,500,000
$13,600,000

At a rate of 4%, the yearly depreciation charge is $544,000.

2. Operating and maintenance costs for a 16 mgd activated sludge plant with filtration would be about $517,700 per year.

3. Interest on the money borrowed by Fayetteville.

If Fayetteville builds the Rockfish system without Ft. Bragg, the cost may be estimated at $4,000,000 for the plant and $5,500,000 for the interceptor sewers or a total of $9,500,000. A 55% EPA grant and a 25% State of North Carolina grant are likely for this sum, so that Fayetteville would receive $7,600,000. If Ft. Bragg is taken into the system, the total cost would be $13,500,000 so that Fayetteville would have to borrow $6,000,000 (Appendix V). This would be financed by general obligation bonds for an average of about 11 years at an anticipated rate of

4.25% to 4.7%. Assuming that an interest rate of 4.5% would be obtained and that the principle would not be reduced for 3 years and then would be reduced on a straight line basis for 16 years, the average interest payment for the first 10 years would be $249,750. Calculations for any longer period of time are of little value due to the uncertainties of expansion and inflation.

Assuming that Ft. Bragg would contribute half of the load to the Rockfish system, the yearly fee charged by Fayetteville to Ft. Bragg would be:

Yearly Depreciation	$544,000
O&M Costs	517,700
Interest Charges on Capital Costs	249,750
	$1,311,450
	x 0.5
	$655,725/yr

In addition, Ft. Bragg would have to build about 30,000 ft of sewer main from the site of the present sewage treatment plant to the boundary at Beaver Creek. This main would be approximately half 24-in. forced and half 36-in. gravity sewer. At $16 per ft and $25 per ft, respectively, the cost would be $615,000. Adjusted to June 1972, this cost would be $738,000.

About 4,500 ft of 24-in. sewer would be required from the present site of pumping station #1 to the large Beaver Creek interceptor. Pumping Station #1 would be eliminated. At $16 per ft, this cost would be $86,000 adjusted to June 1972.

The size of the sewer required from the site of pumping station #2 is difficult to estimate because the pump capacity is the same as station #1, while the flow is only 90,000 gal per day. According to Ft. Bragg personnel, the flow may decrease to zero in the future. Conveyance of the present flow to the Beaver Creek interceptor must be accomplished, however. Assuming a 12-in. trunk main, 5,500 ft at $10 per ft, the adjusted cost would be $66,000. Pumping station #2 would be eliminated.

A possibility at pumping station #3 is to eliminate it and build a trunk main over to the Beaver Creek interceptor. This would require about 500 ft of about 15-in. line and cost about $72,000.

Pumping station #4 may also be eliminated. However, the best solution for the present may be to leave it as it is until it becomes more troublesome.

Finally, Ft. Bragg would have to build a large pumping station at the site of its present sewage treatment plant. At 6000 gpm peak flow in a 16-in. pressure main for 15,000 ft against a 130 ft static head, the total dynamic head would be about 520 ft. This would require two or more separate pumping stations. To reduce the total dynamic head, a 24-in. pressure main is chosen for which the total dynamic head should be about 186 ft. A pumping station with three, 300 hp pumps capable of 300 gpm each would be required and the cost, including a wetwell, would be about $500,000. Amortized at 6% for 25 years, this station would cost $39,000 per year. Electricity would cost about $20,000 per year and total O&M would be about $35,000 per year.

Table 6
Costs for Fayetteville's Treating All of Ft. Bragg's Wastewater—Stated Terms
(in thousands of dollars)

Item	Capital Cost	Amortized Capital Cost	O&M	Yearly Cost to Gov't
Payment to Fayetteville			$656	$656
Large Sewer	$ 738	$ 58		58
#1 Site Sewer	86	7	assumed	7
#2 Site Sewer	66	5	to equal	5
#3 Site Sewer	72	6	reduction	6
			in old	
			O&M	
			costs	
Pumping Station	500	39	35	74
TOTAL	$1,462	$115	$691	$806

Ft. Bragg's total yearly costs for having Fayetteville treat its wastes are summarized in Table 6.

Estimated Costs If Fayetteville Treats the Gravity Portion of Ft. Bragg's Wastewater. Dividing the wastewater from Ft. Bragg so that Fayetteville would treat only that portion from the natural Beaver Creek and Rockfish Creek watershed has both positive and negative aspects. The obvious advantage is the elimination of major pumping stations by utilizing gravity flow to the utmost. Dual administration may be inefficient, however, and Ft. Bragg would still have to upgrade its treatment facility.

Fayetteville charges:

1. 4% depreciation on Rockfish plant and interceptor sewers per year.

10 mgd Plant	$4,920,000
Sewers	5,500,000
Increase in sewers (Appendix III)	500,000
	$10,920,000
	×.04
	$ 436,800

2. Operating and maintenance costs for a 10 mgd plant with filtration would be $367,000 per year.

3. Interest on Fayetteville borrowing $4,430,000 ($10,920,000 minus 7,600,000) calculated as before gives an average interest charge over the first 10 years of $123,255 per year.

Assuming that Ft. Bragg would contribute 0.2 of the load to the Rockfish system, the yearly fee charged by Fayetteville to Ft. Bragg would be:

$436,800
367,000
123,255
$927,055
×0.2
$185,411 per year

In addition, Ft. Bragg would have to build sewers to eliminate pumping stations #1, #2, and #3 as well as build its own plant. The total costs are summarized in Table 7.

Other Methods of Computing Fayetteville's Charges. Fayetteville's charges were calculated on the basis of a contractual agreement. This involves a depreciation charge to Ft. Bragg on the total capital costs including the contribution of the Federal EPA and the State of North Carolina. The following calculations represent a direct capital cost contribution by Ft. Bragg for added capacity to the Fayetteville system. These are the best possible terms that could be negotiated.

For Fayetteville treating all of Ft. Bragg's wastewater, the added capital cost to the plant and interceptor system would be $13,600,000 – $9,500,000 = $4,100,000. Table 8 lists the total costs for Fayetteville's treating all of Ft. Bragg's wastewater under the most favorable terms.

For Fayetteville's treating only the gravity portion of Ft. Bragg's wastewater, the added capital cost to the plant and interceptor system would be $10,920,000 – $9,500,000 = $1,420,000. Table 9 lists the total costs for Fayetteville's treating the gravity flow portion of Ft. Bragg's wastewater under the most favorable terms.

Table 10 summarizes the yearly cost of all of the alternatives.

5 DISCUSSION

From Table 10, the most economical alternative for the Government appears to be for Ft. Bragg to continue treating its own wastewater. Even on the best terms that could be negotiated, a cooperative system with Fayetteville would cost more in all cases except for Ft. Bragg's yearly payment (O&M) with Fayetteville treating all of their wastewater. Ft. Bragg's O&M costs include no capital expenses, however, so this alternative is really not most economical.

Several other considerations are relevant. It may be noted that the costs used in this analysis are substantially higher than the costs expected by the Fayetteville Public Works commission, which are believed to be unrealistically low. Furthermore, the estimates in this analysis are for conventional activated sludge systems. Fayetteville is planning an extended aeration plant that should be considerably more expensive. Expansion of an extended aeration plant may be accomplished very cheaply, however, by conversion to a conventional process. As the Rockfish plant expands, the total cost per 1000 gallons should decrease significantly. This decrease may be offset by the general inflation of construction costs for expansion in later years.

Under Executive Order 11507 (Sec. 4, a, 3), "The use of municipal or regional waste collection or disposal systems shall be the preferred method of disposal of wastes from Federal facilities. Whenever use of such a system is not feasible or appropriate, the heads of agencies concerned shall take necessary measures for the satisfactory disposal of such wastes ...." Four military installations which now have or are negotiating for a cooperative wastewater treatment system were contacted for information. In general, these installations do or will contribute less than 20% of the system flow. L. G. Hanscom Field near Bedford, Massachusetts, pays the City of Lexington an annual fee, which is periodically adjusted. They originally paid a connection charge, and their contract stipulates a maximum discharge rate. Ft. Belvoir, Virginia, presently has two small trickling filters, but is negotiating to connect to a line which is planned to pass through Ft. Belvoir to a 10 mgd lower Potomac plant in Fairfax County. A very high connection fee of $.85/1000 gallons is being demanded. Ft. Lee had agreed upon a plan with Hopewill, Virginia, to build a cooperative system. This system was not approved because it was not a regional system. A regional system is now being planned and negotiations are in progress. Ft. Jackson is negotiating with Columbia, South Carolina, for 12.5% of the flow in a proposed new system. Pay structures for these combined systems have usually involved a connection fee or a capital cost contribution. Annual charges are often fixed on a pre-set percentage of flow volume.

In general, there has to be a considerable size difference between two systems in order to afford to transport wastewater very far. The distance between a

Table 7
Costs for Fayetteville's Treating the Gravity Portion of Ft. Bragg's Wastewater—Stated Terms
(in thousands of dollars)

Item	Capital Cost	Amortized Capital Cost	O&M	Yearly Cost to Gov't
Payment to Fayetteville			$185	$185
6 mgd Plant	$3,300	$258	255	513
#1 Site Sewer	86	7		7
#2 Site Sewer	66	5		5
#3 Site Sewer	72	6		6
TOTAL	$3,524	$276	$440	$716

Table 8
Costs for Fayetteville's Treating All of Ft. Bragg's Wastewater—Best Terms
(in thousands of dollars)

Item	Capital Cost	Amortized Capital Cost	O&M	Yearly Cost to Gov't
Added Capacity	$4,100	$321	$259	$580
Large Sewer	738	58		58
#1 Site Sewer	86	7		7
#2 Site Sewer	66	5		5
#3 Site Sewer	72	6		6
Pumping Station	500	39	35	74
TOTAL	$5,562	$436	$294	$730

Table 9
Costs for Fayetteville's Treating the Gravity Portion of Ft. Bragg's Wastewater–Best Terms
(in thousands of dollars)

Item	Capital Cost	Amortized Capital Cost	O&M	Yearly Cost to Gov't
Added Capacity	$1,420	$111	$ 73	$184
6 mgd plant	3,300	258	255	513
#1 Site Sewer	86	7		7
#2 Site Sewer	66	5		5
#3 Site Sewer	72	6		6
TOTAL	$4,944	$387	$328	$715

Table 10
Ft. Bragg's Wastewater Treatment and Cost Alternatives
(in thousands of dollars)

Alternative	O&M	Yearly Cost to Gov't
Ft. Bragg treating its own wastewater with a new A.S. plant including tertiary filtration	$324	$650
Fayetteville treating all of Ft. Bragg's wastewater–stated terms	691	806
Fayetteville treating all of Ft. Bragg's wastewater–best terms	294	730
Fayetteville treating gravity portion of Ft. Bragg's wastewater–stated terms	440	716
Fayetteville treating gravity portion of Ft. Bragg's wastewater–best terms	328	715

city of 10,000 and a city of 100,000 would have to be less than 10 miles for it to be economical to send the small city's sewage to the large city's plant. The critical distance for two cities of 50,000 each is about 4 miles.[4] The distance from the present Ft. Bragg treatment plant to the proposed Rockfish plant is about 25 miles. This is a very large distance to transport Ft. Bragg's sewage, and the principle reason why the economics favor Ft. Bragg's continuing to treat its own wastewater.

[4] Paul B. Downing, *The Economics of Urban Sewage Disposal* (Praeger, 1969).

6 CONCLUSIONS

Present North Carolina standards for 85% removal of BOD_5 and suspended solids are lenient when compared to those of other states. The standards may be expected to become stricter in the near future.

The present Ft. Bragg sewage treatment plant, although well-operated, cannot always meet the 85% removal requirements of the State of North Carolina.

Present choices for Ft. Bragg should be limited to initiating the design of a new wastewater treatment plant or an extensive modernization of the present facility.

The riparian rights of any downstream users would not be violated if Ft. Bragg does not return its treated wastewater to the Little River.

Keeping the present wastewater treatment plant on stand-by in any new system could provide for emergencies or for mobilization.

Ft. Bragg's reported cost ($.06/1000 gals) for wastewater treatment is unreasonably low. It does not include all the costs necessary for a valid comparison with other systems.

Economics favor Ft. Bragg continuing to treat its own wastewater.

7 RECOMMENDATIONS

Ft. Bragg should initiate planning and programming of: (a) a new tertiary wastewater treatment plant to replace the present plant, but not necessarily limited to the treatment configuration used for cost analysis in the report, or (b) extensive modernization of the existing plant to include additional (tertiary) treatment operations.

Ft. Bragg should continue efforts to improve the efficiency and condition of the existing wastewater collection system.

CITED REFERENCES

Comprehensive Water and Sewer Plan, Cumberland County, North Carolina (Wilbur Smith & Associates, 1971).

Downing, Paul, B., *The Economics of Urban Sewage Disposal* (Praeger, 1969).

Engineering News-Record, 2nd Quarterly Cost Roundup, Vol 188, No. 25 (McGraw Hill, 1972) pp 65, 67.

Report on Waste Disposal Practices at Ft. Bragg Army Reservation (Environmental Protection Agency, Region IV, 1972).

Rules, Regulations, Classifications, and Water Quality Standards Applicable to the Surface Waters of North Carolina (North Carolina Department of Water and Air Resources, 1970).

UNCITED REFERENCES

Evans, David R. and Jerry C. Wilson, "Capital and Operating Costs–AWT," *Journal Water Pollution Control Federation*, Vol 44, No. 1 (1972) p 1.

Smith, R., "Cost of Conventional and Advanced Treatment of Wastewater," *Journal Water Pollution Control Federation*, Vol 40 (1968) p 1546.

APPENDIX I

CLASSIFICATION OF THE SURFACE WATERS OF NORTH CAROLINA.*

3. Class A-II Waters

a. Best Usage of Waters. Source of water supply for drinking, culinary or food-processing purposes and any other best usage requiring waters of lower quality.

b. Conditions Related to Best Usage: The waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection with additional treatment if necessary to remove naturally present impurities, will meet the "Public Health Service Drinking Water Standards" and will be considered safe for drinking, culinary or food-processing purposes.

4. Quality Standards Applicable to Class A-II Waters

Items	Specifications
a. Floating solids; settleable solids; sludge deposits.	Only such amounts attributable to sewage, industrial wastes or other wastes as will not, after reasonable opportunity for dilution and mixture of same with the receiving waters, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary, or food-processing purposes, injurious to fish and wildlife, or impair the waters for any other best usage established for this class.
b. Sewage, industrial wastes, or other wastes.	None which are not effectively treated to the satisfaction of the Board and in accordance with the requirements of the State Board of Health.
c. Odor-producing substances contained in sewage, industrial wastes, or other wastes.	Only such amounts, whether alone or in combination with other substances or wastes, as will not, after reasonable opportunity for dilution and mixture of same with receiving waters, cause taste and odor difficulties in water supplies which cannot be corrected by treatment as specified under "Conditions Related to Best Usage," impair the palatability of fish, or have a deleterious effect upon any best usage established for waters of this class.
d. Phenolic compounds.	Not greater than 0.001 mg/1 (phenols).
e. pH.	Shall be normal for the waters in the area, which generally shall range between 6.0 and 8.5 except that swamp waters may have a low of 4.3.
f. Total hardness.	Not greater than 100 parts per million as $CaCO_3$.
g. Dissolved oxygen.	Not less than 6.0 mg/1 for natural trout waters; 5.0 mg/1 for put-and-take trout waters; not less than a daily average of 5.0 mg/1 with a minimum of not less than 4.0 mg/1 for nontrout waters, except that swamp waters may have lower values if caused by natural conditions.

* *Rules, Regulations, Classifications, and Water Quality Standards Applicable to the Surface Waters of North Carolina* (Department of Water and Air Resources, 1970).

h. Toxic wastes; oils; deleterious substances; colored or other wastes.	Only such amounts, whether alone or in combination with other substances or wastes as will not render the waters unsafe or unsuitable as a source of water supply for drinking, culinary, or food-processing purposes, injurious to fish and wildlife or adversely affect the palatability of same, or impair the waters for any other best usage established for this class.
i. Organisms of coliform group.	Not to exceed 5000/100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20% of the samples examined during any one month; nor exceed 20,000/100 ml in more than 5% of such samples. Fecal Coliforms (MPN or MF count) not to exceed a log mean of 1,000/100 ml based on at least five consecutive samples examined during any 30-day period; nor exceed 2,000/100 ml in more than 20% of the samples examined during such period. (Not applicable during or immediately following periods of rainfall.)
j. Temperature.	Not to exceed 5°F. above the natural water temperature, and in no case to exceed 84°F. for mountain and upper piedmont waters and 90°F. for lower piedmont and coastal plain waters. The temperature of natural trout waters shall not be significantly increased due to the discharge of heated liquids and shall not exceed 68°F.; however, the temperature of put-and-take trout waters may be increased by as much as 3°F. but the maximum may not exceed 70°F.
k. Radioactive substances.	Gross beta activity (in the known absence of Strontium-90 and alpha emitters) not to exceed 1,000 picocuries per liter.

9. Class D Waters

a. Best Usage of Waters: Agriculture, industrial cooling and process water supply, fish survival, navigation, and any other usage, except fishing, bathing, or as a source of water supply for drinking, culinary or food-processing purposes.

b. Conditions Related to Best Usage: The waters without treatment and except for natural impurities which may be present therein will be suitable for agricultural uses and will permit fish survival. The waters will also be usable after special treatment by the user as may be needed under each particular circumstance for industrial purposes, including cooling and process waters.

10. Quality Standards Applicable to Class D Waters

Items	Specifications
a. Floating solids; settleable solids; sludge deposits.	Only such amounts attributable to sewage, industrial wastes or other wastes as will not, after reasonable opportunity for dilution and mixture of same with the receiving waters, render the waters unsuitable for agri-

	culture, industrial cooling purposes and fish survival, or cause an offensive condition.
b. pH.	Shall be normal for the waters in the area, which generally shall range between 6.0 and 8.5, except that swamp waters may have a low of 4.3.
c. Dissolved oxygen.	Not less than 3.0 mg/1.
d. Toxic wastes; oils; deleterious substances; colored or other wastes.	Only such amounts attributable to sewage, industrial wastes or other wastes as will not render the waters unsuitable for agriculture, industrial cooling purposes, navigation, fish survival, or cause offensive conditions.
e. Organisms of coliform group. (Applicable only to waters designated by the Board for irrigation of fruits and vegetables.)	Fecal coliforms not to exceed a log mean of 1,000/100 ml (MPN or MF count) based upon at least five consecutive samples examined during any 30-day period; nor exceed 2,000/100 ml in more than 20% of the samples examined during such period. (Not applicable during or immediately following periods of rainfall.)
f. Temperature.	Not to exceed 5°F. above the natural water temperature and in no case to exceed 84°F. for mountain and upper piedmont waters and 90°F. for lower piedmont and coastal plain waters.

APPENDIX II
COSTS OF FAYETTEVILLE, NC, TREATING FT BRAGG'S WASTEWATER

PWC
PUBLIC WORKS COMMISSION
OF THE CITY OF FAYETTEVILLE
Electric & Water Utilities
Rates Regulated by a Local Commission for the Benefit of Customers
808 PERSON STREET • P. O. DRAWER 1089 • FAYETTEVILLE, NORTH CAROLINA 28302 • TELEPHONE (AREA CODE 919) 483-1382

June 14, 1972

Mr. Danny Nelson
Environmental Engineering Branch
Department of the Army
Construction Engineering Research Laboratory
Post Office Box 4005
Champaign, Illinois 61820

Subject: Cost Information Regarding Sanitary Sewage Collection and Treatment in Respect to Service to Fort Bragg, North Carolina, By The City of Fayetteville, North Carolina (Your File CERL-PE)

Dear Mr. Nelson:

I shall endeavor to provide you the information you requested in your letter to me dated June 7, 1972; and you will note from the information below that there evidently was a misunderstanding in respect to incremental cost and average system cost.

1. It is proposed for this Commission to complete the Beaver Creek and Rockfish Creek Interceptor sanitary sewers and the Rockfish waste treatment plant in approximately five and one-half years. Present plans do call for an initial 8 mgd plant, costing about $2.5 million to $3 million, including engineering services and contingencies.

2. This Commission would charge Fort Bragg for sanitary sewer service on an actual cost basis, but such cost would be determined by the average system cost per thousand gallons each year.

a) Fort Bragg would pay a cost per thousand gallons equal to the average cost for the Rockfish system per thousand gallons for collection and treatment. Such costs would include the following:

1) Four per cent (4%) annual depreciation of the capital costs of the Beaver Creek and Rockfish Creek interceptor sanitary sewers.

2) Four per cent (4%) annual depreciation of the capital costs of the Rockfish waste treatment plant, for whatever size plant is constructed.

3) Maintenance costs for the Rockfish interceptor sewers (which would be nominal).

4) Maintenance and operating costs for the Rockfish waste treatment plant.

5) Annual interest on money borrowed by City of Fayetteville for Rockfish interceptor sewers and plant.

6) The capital costs to be depreciated would be the total costs of the Rockfish interceptor sewers and waste treatment plant.

7) Since the Rockfish interceptor sewers and treatment plant will be a new system completely, no depreciation or costs involved in the operation and maintenance of the existing Fayetteville Cross Creek system and plant would be included in the cost to Fort Bragg.

8) There will be, initially, one pumping station on the Beaver Creek interceptor sewer, near Cumberland Road, pumping over to the Buckhead Creek interceptor sewer, and thence by gravity to the Rockfish plant.

The above arrangement is the one this Commission would, I believe, prefer for sanitary sewer service to Fort Bragg, providing financing of the additional capacity necessary to serve Fort Bragg is possible by the City of Fayetteville.

If such financing cannot be arranged by the City of Fayetteville, then it seems that an alternative would be for Fort Bragg or the Army to pay the additional or incremental capital costs of interceptor sanitary sewers and plant required for service to Fort Bragg, and, of course, eliminate annual depreciation and interest in the charges per thousand gallons to Fort Bragg.

It would be Fort Bragg's responsibility to install a meter at the connection point of its collection line to the Beaver Creek interceptor sanitary sewer.

The plans of the Rockfish sanitary sewage system and plant in the Wilbur Smith Study are the original plans by this Commission. This Commission is accelerating the Comprehensive Water and Sewer Plant of Cumberland County. The interceptor sewers along Beaver Creek and Buckhead Creek have been sized to serve the entire drainage basin in that area.

Engineering of the Rockfish interceptor sewer is not completed. The 60-inch diameter pipe would perhaps be best for the entire drainage basin, but because of costs a smaller diameter pipe might be constructed initially, and a parallel interceptor constructed later.

In general, this Commission stands ready to serve Fort Bragg as outlined in this letter, or by alternatives that are fair and would not impose any cost (directly or indirectly) for such service on the citizens of Fayetteville.

Please let me know if I can furnish any other information.

Very truly yours,

PUBLIC WORKS COMMISSION

R. A. Muench, Jr.
Manager

RAMJr:jrw

APPENDIX III

EFFECT OF FT. BRAGG ON THE COST OF FAYETTEVILLE'S SEWERS

1. Section from Ft. Bragg to McFadyan Lake

Data: 21,000 ft., 30 ft. drop

	With Ft. Bragg	Without Ft. Bragg	With Gravity Portion of Ft. Bragg
Size (in)	36	15	24
Cost ($)	630,000	302,400	403,200

2. Section from McFadyan Lake to Rockfish Creek

Data: 27,000 ft., 30 ft. drop

	With Ft. Bragg	Without Ft. Bragg	With Gravity Portion of Ft. Bragg
Size (in)	42	24	30
Cost ($)	832,500	444,000	555,000

3. Section from Beaver Creek to Big Sandy Run

Data: 38,000 ft., 70 ft. drop

	With Ft. Bragg	Without Ft. Bragg	With Gravity Portion of Ft. Bragg
Size (in)	42	30	36
Cost ($)	1,368,000	912,000	1,140,000

4. Section from Big Sandy Run to the Rockfish Plant

Data: 10,000 ft., 10 ft. drop

	With Ft. Bragg	Without Ft. Bragg	With Gravity Portion of Ft. Bragg
Size (in)	48	36	42
Cost ($)	420,000	300,000	360,000

5. Total cost differences

With Ft. Bragg		Without Ft. Bragg	With Gravity Portion of Ft. Bragg
$ 630,000		$ 302,400	$ 403,200
832,000		444,000	555,000
1,368,000		912,000	1,140,000
420,000		300,000	360,000
3,250,000	Total	$1,958,400	2,458,200
1,958,400			1,958,400
$1,292,100	Difference		$4,999,600

APPENDIX IV
FAYETTEVILLE'S CHARGES TO TREAT FT BRAGG'S WASTEWATER

TELEPHONE OR VERBAL CONVERSATION RECORD
For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 3 July 1972

SUBJECT OF CONVERSATION: Fayetteville Charges to Treat Ft. Bragg's wastewater

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
D. Nelson	CERL-ESN	217-356-1151, x 411
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**
R. A. Muench	P.O. Drawer 1089 Fayetteville, NC 28302	919-275-9111 483-1382

SUMMARY OF CONVERSATION

1. 2, a, 1 on 14 June 1972 letter from Mr. Muench refers to the total Rockfish system interceptors.

2. Present cost estimate for 8 mgd plant = $\$3.5 \times 10^6$.
   Present cost estimate for 8 mgd plant and all interceptors = $\$8.5 - \$9 \times 10^6$.
   Estimate $\$10-\$11 \times$ (top of head) $\times 10^6$ with Ft. Bragg.

3. General obligation bonds
   4.25 - 4.7%
   Max. 18-19 years
   Ave. 11 years

D. NELSON
Environmental Engineering Branch

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 58 WHICH WILL BE USED.

☆ GPO: 1966 200-500/66

APPENDIX V
EFFECT OF A COMBINED SYSTEM ON STATE AND FEDERAL GRANTS

TELEPHONE OR VERBAL CONVERSATION RECORD
For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 5 June 1972

SUBJECT OF CONVERSATION
Effect of Combined Fort Bragg and Fayetteville Wastewater Treatment System on Federal and State of North Carolina Grants

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
Dave Olsen	EPA, Room 408, 1421 Peach St., (N.E.), Atlanta, Georgia	404-526-5784
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**
Dan Nelson	CERL-PE	ext. 411

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**

SUMMARY OF CONVERSATION

1. This call was a response to a call made earlier on 5 June 1972 by Mr. Nelson of CERL to Mr. Olsen of the Federal Facilities Branch of the EPA.

2. Mr. Olsen stated that:

a. Federal facilities will receive no funding help from the EPA on construction projects.

b. The cost of a project eligible for Federal funding will be calculated with and without the effect of the participation of a Federal facility.

c. EPA and matching state grants will support an eligible project as if it were to be built without the participation of a Federal facility.

d. If a project is built in which a Federal facility participates, the Federal facility will pay the whole of the difference in the cost of the project resulting from its participation.

3. Mr. Art Linton, Head of the Federal Facilities group at Atlanta, should be contacted if further information is needed.

D. NELSON
Environmental Engineering Branch

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 56 WHICH WILL BE USED. ☆ GPO: 1966 390-900/66